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Much of Reclamation's prior effort in cavitation research has centered on the study and prediction of cavitation damage caused by high velocity flows over isolated and distributed surface irregularities. In 1990, Engineering Monograph 42, Cavitation in Chutes and Spillways, by Henry Falvey, was published by Reclamation and remains one of the leading references on cavitation in hydraulic structures today.

Damage caused by cavitation can be very expensive to repair and, in extreme cases, cause concern for the safety and integrity of the structure. There are good predictive tools for cavitation damage in chutes and spillways caused by geometric effects or surface irregularities. However, cavitation damage can often be initiated in shear layers and vortex cores. This type of cavitation is not easily predictable. In addition, the damage from this type of cavitation may occur only at conditions of high heads and flows, not necessarily "normal" conditions. Shear layer and vortex cavitation are generally associated with mechanical equipment, such as gates and valves, but can also occur in tunnel spillways and chutes that are subject to intense secondary flows. Shear layer cavitation has been identified as a probable cause for the 1997 failure of the Flaming Gorge outlet works conduit. The damage patterns and subsequent model study of the severe cavitation damage to the Folsom Dam outlet works conduits also point to shear layer and/or vortex flows being responsible for the initiation of damage.

The major goal is to develop a computational tool that will allow users to enter information about their structure and hydraulic conditions and in return receive information about the cavitation potential of that structure under various operating conditions. Several steps along the way are seen as study objectives:

- Review cavitation literature dealing with shear layers and vortices - especially in the area of naval hydrodynamics
- Perform computational fluid dynamics modeling (three-dimensional) on the Folsom Dam outlet works in order to identify flow conditions which could have led to the damage which occurred in 1997
- Formulate a detailed experimental plan and design, construct a model, and perform studies in the Low Ambient Pressure Chamber (LAPC)
- Analyze data and incorporate into a predictive computer model
- Prepare a comprehensive report and user's guide for the predictive model

A thorough literature review was completed, including reviewing many studies involving naval hydrodynamics. Three-dimensional turbulent flow simulations on a Folsom Dam outlet works high pressure slide gate were completed and showed some interesting results. A very dense computational grid around the area of the gate was used to demonstrate vortices that originated at the conduit roof, upstream from the gate, and passed through the gate structure. Very high strength circulation zones were present in the gate slots. However, low pressure regions on the side walls and floor where cavitation damage had occurred in the prototype were not predicted. Discussions with a visiting professor from Graz Technical University in Austria forced us to rethink the approach to the research. The slide gate model planned for the LAPC was abandoned due to the feeling that the computational model had shown that evidence of a cavitating vortex did exist. We decided that a different type of flow should be studied to lend further evidence and insight into this problem. The secondary flow present in the vertical bends of tunnel spillways was long thought to be a source for cavitating vortices. New evidence of damage at Kortes Dam also points toward this mechanism as the primary cause of the damage. For this reason, modeling efforts have turned in this direction and await additional funds.

Frizell, K. Warren. December 1999. Eliminating Cavitation, Erosion Damage at Folsom Dam. Hydro Review Magazine.